DIPHTHERIA.

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Gentlemen of the Massachusetts Medical Society:

In endeavoring to respond to the invitation of your Committee to read a paper at this meeting I have ventured to select Diphtheria as the subject of my paper because the disease has lately prevailed in an epidemic form in Lowell and vicinity. In writing upon diphtheria I do not expect to be able to offer much that is new or original, but shall, at first, give a general account of the disease, then make some observations regarding its nature, and give what experience has suggested respecting its treatment.

DEFINITION.

Dr. Aitken in his great work on the Science and Practice of Medicine (6th Ed. 1872) defines diphtheria as "A specific disease with membranous exudation on a mucous surface, generally of the mouth fauces and air passages, or occasionally on a wound. The disease is attended with great prostration of vital powers. In some cases a remarkable series of nervous phenomena are apt to supervene, characterized by progressive paralysis and sometimes by fatal syncope. The disease is contagious and apt to become epidemic."

HISTORY.

Although the name diphtheria is a modern invention of Bretonneau, the disease which we now recognize by that appropriate designation has existed under different names for centuries if not from all antiquity; and although the Greek and Roman writers have not described its features with sufficient distinctness its epidemics have been clearly indicated by Spanish, Italian, French, German, Swedish, British and American authors from the end of the sixteenth century to the present time. The earliest account of an epidemic that was undoubtedly diphtheria, whice I have been able to find is one which broke out in Holland in 1517. (Guy on Public Health.) It is described as an infectious inflammation of the throat which often caused death in twenty-four hours. Those who ultimately got well recovered slowly. The disease soon passed away, but it spread beyond the limits of Holland, and certainly to Basle in Switzerland, where in the space of eight months it killed 2000 people. Here its symptoms appear to have been better described, for we learn that the "tongue and throat were white as if covered with a mould," and part of the treatment consisted in removing this "viscous white coating" before applying remedies. Dr. John Starr, in 1749, describes, under the name of Morbus Strangulatorius, a disease which he says "has reigned within a few years in several parts of Cornwall with great severity." In his description we recognize diphtheria. He speaks of a "white body seen on the palate and tonsils," and gives a wood cut of a membraneous cast of the larynx, trachea and primary bronchi which was expectorated by one of his patients. He

speaks of the formation of a white membrane on a blistered cutaneous surface. Dr. Huxham, in his dessertation on Malignant Ulcerous Sore Throat (3rd Ed. 1759), evidently confounds together the two diseases, scarlet-fever and diphtheria. We recognize diphtheria in his description of "ash colored spots on the tonsils, uvula, palate and pharynx," and in the noisy breathing "resulting from extention of the disease to the windpipe." He speaks of the "discharge from the nostrils as being so acrid that it excoriated the lips and hands of the patients," showing the extension of the disease to the nasal cavity. In 1765 Dr. Home published his treatise on the Nature, Cause and Treatment of Croup. He was the first to describe a membrane lining the air passages as the essential anatomical character of Croup. A careful study of his cases shows that under the name of croup he included two different diseases—simple laryngitis and diphtheria. Dr. Samuel Bard, in 1771, published an admirable description of diphtheria under the title of Angina Suffocativa, or Sore Throat Distemper, as it appeared in New York. He speaks of a "membrane on the tonsils" as being frequently, but not invariably, present. He describes the formation of a membrane on the abraded skin; and he recognizes the infectiousness of the disease but rather "from the breath of the infected person" than "from any prevailing disposition of the air." And this, he says, explains the fact that a whole family may suffer from the disease while the next door neighbors escape. He speaks of one family in which seven cases occurred three of which were fatal. Cullen, in his First Lines of the Practice of Physic, (4th Ed. 1784,) under the head of Cynanche Maligna evidently includes scarlatina anginosa and diphtheria. The latter is indicated by the appearance of white or ash-colored spots on the fauces. Mr. Henry Rumsey in Account of Croup as it appeared in the Town of Chesham in Buckinghamshire, in 1793-4, says that "frequently large films of white substance were formed on the tonsils, and describes a film or membranous substance lining the windpipe. Dr. Cheyne in his treatise on the Pathology of the Membrane of the Larynx and Bronchi, published in 1809, says: I have seen children so affected that I at first imagined they were suffering from the second stage of croup, but upon examination I discovered "sloughs on the tonsils and uvula." The cough, voice and breathing were those of the second stage of croup. He doubts whether these were cases of "true croup", but it can scarcely be doubted now that they were cases of diphtheria. Dr. Wade in a communication to the British Medical Journal in 1875, gives the following quotations from an old author showing that the existence of symptoms which we now recognize as diphtheritic paralysis was noted. They are extracted from a book entitled: An Historical Dissertation on a Particular Species of Gangrenous Sore-Throat, which reigned last year among the Young Children at Paris. Translated from the French of Dr. Chomel (printed at Paris in 1749) by N. Torriano, M. D., London, 1753. "Miss Blossac aged six and a half years . . . . . The patient did not seem to be quite out of danger till the forty-fifth day of the disease; having always a pain in expressing herself, speaking through her nose by reason of the fallen palate. She was given in order to lessen the disagreeable speaking through her nose, a little camphorated brandy, with equal parts of warm water to draw up her nose, for two months together, and she used the remedy with pleasure. "Miss Bonac was taken ill of the disease and cured . . . . . I have since learned that this patient after the fortieth day of the disease spoke much through her

nose, became squint-eyed and deformed, but that as she grew stronger she also regained day by day her natural state." The writer says "the patients are a long time weak and languid." To Bretonneau, however, belongs the honor of having clearly elucidated the distinctive characteristics of the affection. In 1821, 1825 and 1826 the disease having broken out and prevailed as an epidemic at Tours in France, Bretonneau with his pupils Velpeau and Trousseau, studied it carefully and found a remarkable uniformity in its symptoms and post mortem appearances and from the constant presence of a false membrane called it diphtheria.

PATHOLOGY.

The characteristic feature of diphtheria as already stated is the presence of a false membrane situated upon the fauces. At the outset of the disease there is redness of the fauces with more or less swelling of one or both tonsils. The exudation usually first appears upon one of the tonsils; but the diphtheritic formation may begin in the nares, pharynx or larynx; on the palatine arches, uvula and the posterior surface of the soft palate. At first the false membrane is thin, but may become more or less thick and opaque, it is white or ash colored, but may become dark and when unusually thick it resembles parchment or chamois leather. Sometimes the exudation is thin and soft and sometimes it is tough and elastic and an eight of an inch in thickness. Different cases differ in the extent of the exudation; one or both tonsils may alone be affected, and from this primary seat the false membrane may extend over the pharynx, soft palate, hard palate, palatine arches, and uvula; into the nares, larynx, trachea, bronchi, œsophagus and even into the stomach. It may be uniformly diffused in these situations, but it is oftener in irregular patches. The diphtheritic growth generally penetrates beneath the epithelium of the mucous membrane into the submucous tissue, coming into close contact with the blood vessels, and if detached a raw bleeding surface is exposed, which is soon covered with a new layer of false membrane.

Sooner or later the false membrane is thrown off, but the exfoliation is not infrequently followed by a second, third, and even fourth formation of false membrane. Decomposition of the exudation often takes place rapidly and hence arises the fetid effluvia exhaled from the mouth of the patient. The glands to which the lymphatics of the pharynx lead are found to be larger, than natural, and such an enlargement of the glands is in just proportion to the extent and severity of the local disease within the throat. If the local disease is limited to one side, the glandular enlargement occurs on the same side, and in severe cases not only do the glands behind the angles of the jaw enlarge, but the connective tissue in which they are situated is often the seat of serous effusion and even of the exudation of lymph, so that great swelling occurs which sometimes results in suppuration. According to Dr. Neimeyer the diphtheritic and croupous false membrane is composed of fibro-albuminous material which rapidly coagulates when thrown out upon the free surface of a mucous membrane. By some authorities it is considered to be a peculiar exudation which forming a favorable nidus for fungi, is often the seat of cryptogamic growth. Others maintain that the fibrinous material is poured out only in consequence of the irritation set up by a parasitic formation ramifying between the epithelial layers of the mucous membrane. Microscopically it is seen that pus, granular corpuscles, oleo-protein granules and epithelium constitute the

bulk of the softer forms of diphtheritic exudation, while fibrin mixed with corpuscles constitute the bulk of the tougher varieties. The microscope often reveals the presence of fungoid vegetation in the pellicle diphtheria and some observers have asserted that a parasitic growth is always present in the false membrane of this disease.

SYMPTOMS.

The invasion of diphtheria is sometimes attended with symptoms so mild as scarcely to attract attention until the local disease has made considerable progress. No pain is felt in swallowing, no febrile excitement is present and only a trifling soreness or roughness is experienced in the throat. Other cases begin with feelings of depression, and general malaise, attended with chills, fever, headache, sore-throat, stiffness of the neck and more or less pain in deglutition, and sometimes an attack is ushered in by convulsions. The *primary nasal form* commences like a cold in the head or the snuffles, the patient is unable to respire through the nostrils; from which there takes place a serous, yellowish, flocculent or bloody discharge, often very fetid, and which produces more or less excoriation of the external nasal openings and of the upper lip. This form is apt to be overlooked until symptoms of exhaustion supervene, or of the extension of the disease to the fauces or larynx. In the *primary laryngeal form* the disease begins with painful deglutition, attended with redness and swelling of the mucous membrane of the fauces, and noisy respiration. The exudation may be often seen on the arches of the palate, being more abundant at the base of the arch, looking as if it had spread from the larynx. Croupal symptoms rapidly supervene and death threatens from apnœa.

MEMBRANOUS CROUP IS DIPHTHERIA.

I believe membranous croup and diphtheria to be identical. On reviewing, lately, the prevailing opinions of the leading members of our profession, it appears they are daily more and more adopting the dogma of Bretonneau and Trousseau that all membranous croup is dependent on the specific contagium of diphtheria. It is, then, unquestionable that in the vast majority, if not in all cases, a membranous exudation in the air passages is the specific product of diphtheria. The absence of exudation on the fauces does not prove the croup to be non-diphtheritic; for the diphtheritic formation may begin in the larynx, or, what is more common, the membranous exudation, which first occurred on the fauces, may become detached therefrom, while the disease is extending downward into the air-passages; so that on inspecting the throat no exudation is observed. It is admitted by the best authorities that the morbid anatomy of membranous croup is identical with that of diphtheria.

SEQUELS.

The sequels of diphtheria form an important part of its history. Anæmia and general debility are apt to persist for a considerable time. Febleness of the action of the heart sometimes exist to such a degree as to lead to sudden death by syncope, which is due in some cases, to a paralysed condition of the heart, and, in others, to the deposition of fibrin in the heart or great vessels. Paralysis is a characteristic sequel, the muscles of the soft palate and pharynx are oftenest affected; the paralysis here precedes its occurrence elsewhere, and is denoted by the nasal sound of the voice, difficulty of swallowing and the regurgitation of liquids through the nostrils. Paralysis of the limbs is gradually developed and is preceded by

tingling, numbness and a sensation of coldness; but sometimes the sensibility of particular parts of the affected limbs is morbidly increased, so that the lightest touch causes great distress. Paralysis of the external recti muscels sometimes occurs resulting in converging squint. The senses of sight, taste, smell and hearing are sometimes affected. Concerning the pathology of diphtheritic paralysis there are several theories. Dr. Morrelli in his essay on Diphtheritic Paralysis, as observed in Florence from 1861 to 1864, gives some dissections in which lesions were found in the spinal cord and nerves. He remarks that the changes found after death are inadequate to explain the various forms of diphtheritic paralysis and leave it an open question whether the pathogenesis of this affection be not entirely due to the morbific causes of diphtheria and whether the paralysis does not proceed from the periphery to the nervous centres. Other Italian and German physicians have described autopsies in which they have found a dissemminated myelitis in the madulla and spinal cord. Two recent observers, M. Charcot and M. Vulpian, are of the opinion that diphtheritic paralysis is due to the peripheric rather than to changes in the nervous centres; that it is in fact an extending neuritis or inflammatory process propagated from the muscular surfaces and nerve extremities, which produce abolition of their functions. They have shown that the normal condition of the palatine nerve is altered; that the nerve tubules are devoid of myeline and granulations are seen to exist in the neurelemma.

NATURE AND CAUSE.

Diphtheria is classed among the zymotic diseases. It is a contagious disease and apt to become epidemic. Examples of persons becoming affected after having been brought in close contact with the disease are numerous. But it sometimes occurs sporadically and shows no disposition to spread from the sick to the healthy. In what manner the specific contagium or poison of diphtheria is generated, has not yet been solved, filth, sewer and cesspool gases, defective drainage, dampness arising from soil moisture, or rather a damp atmosphere charged with the fungi of decomposition, are said to give rise to the disease. A German author, Dr. Letzerich, says "that it is undoubtedly deduced that epidemic diphtheria is caused by a fungus whose spores can carry the disease to other individuals; that diphtheritic inflammation depends upon the local effects of cryptogamic productions and that clinical experience shows that the false membrane may be prevented if the spores and sporules are destroyed by topical applications" Once originated from any cause or combination of causes it may be communicated by the sick to the healthy.

I regard diphthria in its incipient stage as a local disease, and the early constitutional symptoms that sometimes occur, as due to the irritation caused by the growth on the mucus membrane, and the ramification beneath its epithelium, of the diphtheritic formation, and I regard the subsequent infection of the system and constitutional disease, as resulting from the absorption from the throat or other seat of the false membrane, of the poison, and of putrescent matters arising from the interstial death of the mucous tissue invaded, and from the decomposition of the false membrane. *We cannot too forcibly impress upon the public that the severity and mortality of the disease can be controlled if it is brought early under treatment.* If this fact was generally known and heeded we could regard the disease as one of the most trivial of throat affections, with here

and there a grave exception. Diphtheria is often masked for a time by symptoms of other diseases, so that when diphtheria is prevalent it is expedient to look into the throat of the patient in all cases of illness, as occasionally when there is not even ground for suspicion the characteristic spot or film of false membrane can be observed. What is the first stage of diphtheria? That in which the germs of the disease have lodged on a surface which provides a favorable soil for their development. The locality which is chosen by the contagium particles of diphtheria is usually the throat, generally one of the tonsils, where they begin to multiply and spread over the adjoining mucous surface, like mould on a raspberry jam. The disease has not yet impregnated the constituton with its baneful influence; perchance the pulse is not quickened; the temperature is not raised and the tongue is not furred. Now is the time when a speedy cure can be effected by local treatment, when a single topical application will often effectually destroy the parasitic growth, and the patient is rescued. Contrast this with the disease not seen until it has been some three or four days established, the poisonous matter from the film has been absorbed by the lymphatics, as indicated by the hardening and swelling of the neighboring glands, the false membrane has spread more or less over the fauces and into the nasal cavity, perhaps entering the larynx, when recovery can scarcely be looked for, the pulse rapid: the temperature exalted, nerve prostration extreme, the blood badly or hopelessly poisoned, and protracted illness or death imminent.

TREATMENT.

In the treatment of the *first stage* of diphtheria I formerly applied to the false membrane lunar caustic or a strong solution of the nitrate of silver; but lately I have used as a local application the following preparation: R.—Acidi carbolici, 15 drops, Tinct. Ferri chloridi, 4 drachms; Aquæ, 4 drachms, M. This solution by its astringent and antiseptic properties tans or hardens the fibers and coagulate the fluids of the false membrane, thereby, arresting its growth and preventing the occurrence of putrefactive changes therein. It should be applied to the false membrane *once*, rarely twice, daily, with a small probang which had been moistened with water and pressed out just before being dipped in the solution. Some physicians experience considerable difficulty in making topical applications to the throat of children, but if they adopt the following procedure they will easily succeed: The mother, sitting, should take the child in her *right arm* and hold its hands; another person standing behind the child should hold its head, while the doctor should depress the tongue with a spatula or spoonhandle held in his left hand, and with his right, apply the probang, dipped in the solution, to the throat; after one application has been made the probang should be rinsed in water, cleaned of the attached mucus, dipped again in the solution and re-applied; this repetition is necessary, so that the solution may come in direct contact with and thoroughly permeate the false membrane. This operation should not be performed oftener than *once* or twice in the twenty-four hours, as strong local applications are apt to do harm when too frequently repeated. One application thoroughly made as directed, in the incipient stage of diphtheria, will oftentimes arrest the disease causing the general symptoms to subside in a short time and the false membrane to shrivel and disappear within twenty-four hours. While the local applications are being made the following

prescription may be administered: R.— Potassii chloratis, 1½ drachms: Aquæ, 4 ounces: Acidi Muriatici, 10 drops. M. Take a teaspoonful every hour during the day and continue its use a few days after the false membrane has disappeared from the throat.

In the *next stage* when the constitution has become impregnated with the diphtheritic poison the false membrane will reappear if it is destroyed: so that local applications, though beneficial, cannot be relied upon to arrest the disease, which should now be chiefly treated by the administration of tonics, antiseptics, stimulants, and a nourishing diet. An excellent prescription contaning tonic and antiseptic qualities and the one which I generally give, is the following: R.— Potassii chloratis, 1½ drachm; Aquæ, 4 ounces; Tinct. Ferri chloridi, ½ to 1 drachm; Quiniæ sulphatis, 2 to 5 grains, M. Take a teaspoonful every hour during the day and continue its use one or two weeks after the local disease has disappeared. Water should not be taken for at least five minutes after each dose of the medicine, so that it may have time for local effect on the fauces. When there is much fetor exhaled from the fauces, the mouth may be occasionally rinsed and the throat gargled or sprayed, with the Liquor Sodæ chlorinatæ, 5 to 20 drops to the ounce of water, or with Aqua chlorinii, 5 to 15 to the ounce of water. Stimulants are required in this stage, the best being sherry wine diluted with an equal quantity of water, and the amount given should be in proportion to gravity of the disease and to the age of the patient. A liquid diet, only, should be allowed consisting of milk, beef essence, beef tea, porridge, gruel, soup etc., until convalescence begins when a more substantial diet may be partaken. In the nasal form, when the discharges are offensive, the nostrils should be carefully syringed out with Potassii permanganas, 1 to 2 grains to the ounce of water, but if there be hemmorrhage, the Tinct. Ferri chloridi, 5 to 10 drops to the ounce of water, may be used.

In the primary laryngeal form, or when the disease is entering, or has extended into the larynx, the following vaporized by the steam atomizer may be almost constantly inhaled for the purpose of effecting the solution of the false membrane: R.—Aquæ calcis, 4 ounces; Acidi carbolici, 10 drops, M. Tracheotomy should be performed when other means have failed, and according to Prof. George Buchanan of Glasgow, the operation yields as successful results in diphtheria as it does in membranous croup. In 1875 he published the whole number of his operations which was 46: for croup 16—cured 6, died 10: for diphtheria 30—cured 11, died 19. The average result is precisely the same, viz: one out of every two and two-thirds is saved.

In the paralysis, resulting from diphtheria, no special treatment is required in most cases, but in the exceptional cases when the paralysis persists, a cure may be generally effected by the use of electricity, the sub-cutaneous injection or the internal administration of strichnine, and an elegible formula is as follows: R.— Strichniæ sulphatis, 1 grain: Aquæ, 1 ounce: Tinct. Ferri chloridi, ½ drachm: Syrupi Zingiberis, 3 ounces, M. Dose for adults, one teaspoonful; for children 1 to 3 years old, five to ten drops, thrice daily.

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